Enhancing wind resistances
FEMA attempts to improve high-wind performances of asphalt shingles and tile
by ***Mark S. Graham***

Following the hurricanes that struck Florida and Alabama in 2004, the Federal Emergency Management Agency (FEMA) issued several new guidelines intended to enhance wind resistances of asphalt shingle and tile roof systems. The new guidelines have been provided to the communities affected by the hurricanes as a resource to improve the wind performances of roof systems during future high-wind events.

In some instances, the guidelines provide practical, common-sense enhancements that should prove to be effective, low-cost means of improving these roof systems' wind resistances. However, in other instances, FEMA's guidelines largely are unsubstantiated, misguided and contrary to best practices of the roofing industry.

Following is a brief overview of FEMA and its latest hurricane-recovery advisories applicable to roof systems, as well as NRCA's opinions about these new guidelines.

FEMA

FEMA, a federal government agency, is tasked with responding to, planning for, recovering from and mitigating natural and manmade disasters. FEMA originally was established by the Congressional Act of 1803 to provide assistance to a New Hampshire town following an extensive fire; the Congressional Act of 1803 generally is considered the United States' first piece of disaster legislation. Since then, ad hoc legislation has been passed more than 100 times to expand FEMA's role to include response to hurricanes, earthquakes, floods and other natural disasters. During the Cold War era, FEMA also was instrumental in orchestrating many of the nation's civil defense preparedness programs.

FEMA recently has taken a more proactive role in coordinating federal, state and local emergency-management programs. In addition to coordinating federal response to disasters and making assistance available, FEMA now routinely provides guidance regarding building codes and flood plain management, supports the nation's fire service, trains and educates people about facing disasters, and administers the national flood insurance and crime insurance programs.

In March 2003, the agency transitioned from being an independent federal agency to becoming part of the U.S. Department of Homeland Security. As a result, in addition to natural disasters, FEMA's efforts now also are directed toward manmade disasters, such as a terrorist attack or war.

Currently, FEMA has more than 2,600 full-time employees and is headquartered in Washington, D.C., with regional and area offices throughout the United States. FEMA also has nearly 4,000 standby disaster-assistance employees who are available for deployment after disasters. In many instances, FEMA partners with other organizations

that are a part of the nation's emergency-management systems. These partners include state and local emergency-management agencies, 27 other federal agencies and the American Red Cross.

Advisories

Following the 2004 hurricanes, FEMA issued three Hurricane Recovery Advisories that specifically apply to improving the wind resistances of asphalt shingle and tile roof systems.

In issuing these advisories, FEMA points out the advisories are not meant to imply new codes or standards. Instead, the advisories are provided to the affected communities in Florida and other interested parties as resources to improve roof system performance in hurricane-prone regions.

Advisory No. 1

Hurricane Recovery Advisory No. 1, "Roof Underlayment for Asphalt Shingle Roofs," provides FEMA-recommended practices for use of roofing underlayments as enhanced secondary water barriers. FEMA views underlayments as key elements in protecting buildings in hurricane-prone regions in the event of asphalt shingle blow-off.

The advisory provides three recommended options for installing underlayments that comply with ASTM D226, "Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing." The three options apply to decreasing resistance to long-term weather exposure following the loss of asphalt shingles. Option 1 provides the greatest reliability and is advocated in heavily populated areas where the design wind speed is 120 mph (54 m/sec) or greater. FEMA does not specifically advocate Option 2. Option 3 provides limited protection and is advocated in areas with modest population density and design wind speeds of 110 mph (49 m/sec) or less.

Common to each of these options is that roof sheathing must be inspected to verify it is nailed as specified on drawings. Also, FEMA calls for a minimum 4-inch- (100-mm-) wide strip of self-adhering modified bitumen tape to be installed over all sheathing joints and used to seal around roof deck penetrations.

Option 1 calls for applying a single layer of ASTM D226, Type II (No. 30) underlayment to the roof sheathing over the entire roof area then installing a single layer of self-adhering modified bitumen complying with ASTM D1970, "Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection." The No. 30 underlayment is specified to be nailed at about 6 inches (150 mm) on center along the laps and at about 12 inches (300 mm) on center along two staggered rows in the field of the underlayment sheets. Roofing nails are specified as low-profile, capped-head nails or thin metal disks ("tin caps") attached with roofing nails.

Option 2 calls for applying two layers of ASTM D226, Type I (No. 15) underlayment, shingle fashion, with offset side laps to the roof sheathing over the entire roof area. Each layer of underlayment is specified to be nailed similar to as specified in Option 1.

Option 3 calls for installing a single layer of ASTM D226, Type I (No. 15) underlayment to the roof sheathing over the entire roof area. The No. 15 underlayment is specified to be tacked in place before applying shingles.

The advisory also provides several general notes recommending underlayment be woven across valleys, double-lapped across ridges (unless there is a continuous ridge vent) and turned up a minimum of 6 inches (150 mm) at wall intersections.

Advisory No. 2

Hurricane Recovery Advisory No. 2, "Asphalt Shingle Roofing for High-wind Regions," provides FEMA's recommendations that can be divided into two categories: materials (products) and installation.

Specific to asphalt shingle products, this advisory recommends organic-reinforced asphalt shingles comply with ASTM D225, "Standard Specification for Asphalt Shingles (Organic Felt) Surfaced With Mineral Granules," and fiberglass-reinforced asphalt shingles comply with ASTM D3462, "Standard Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules." For SBS-modified bitumen shingles, though a specific product standard does not currently exist, the advisory recommends compliance with ASTM D3462.

In addition to complying with the applicable product standard, the advisory also recommends using asphalt shingles that comply with additional physical tests and wind tests. Where design wind speeds are 120 mph (54 m/sec) or less, the advisory recommends using asphalt shingles with fastener pull-through resistances of a minimum of 25 pounds (110 N) (tested at 70 F [21 C]) and a minimum tab sealant bond strength of 12 pounds (53 N). Where design wind speeds exceed 120 mph (54 m/sec), values of a minimum of 30 pounds (135 N) and 17 pounds (75 N), respectively, are recommended.

For wind-resistance testing, the advisory does not recommend using ASTM D3161, "Standard Test Method for Wind-Resistance of Asphalt Shingles (Fan-Induced Method)," or UL 997, "Wind Resistance of Prepared Roof Covering Materials," which are recognized in the roofing industry and most building codes, because, in FEMA's opinion, the test methods "... do not provide adequate information regarding the wind performance of shingles ... ." Instead, the advisory recommends shingle uplift loads be calculated according to UL 2390, "Test Method for Wind Resistant Asphalt Shingles with Sealed Tabs," and shingles have bond strengths determined by ASTM D6381, "Standard Test Method for Measurement of Asphalt Shingle Mechanical Uplift Resistance," that are at least two times as high as the load calculation.

Regarding asphalt shingle installation, the advisory recommends enhanced installation procedures at eaves, rake edges, and hips and ridges.

At eaves, the advisory recommends starter shingles be nailed with six nails per strip, 1 inch to 2 1/2 inches (25 mm to 65 mm) from the leading edge. Then, application of three 1-inch- (25-mm-) diameter dabs of roof cement per overlying shingle tab is recommended over the starter shingles before the first course of full shingles is applied.

Along rake edges, application of two 1-inch- (25-mm-) diameter dabs of asphalt cement are recommended on the metal drip edge, as well as two additional similarly sized dabs for asphalt cement in the unexposed lap area of each shingle course.

At hips and ridges, application of two 1-inch- (25-mm-) diameter dabs of asphalt cement are recommended on each side of the unexposed portion of each ridge shingle.

Advisory No. 3

Hurricane Recovery Advisory No. 3, "Tile Roofing for Hurricane-prone Areas," provides recommended practices for designing and installing extruded concrete and clay tiles that will enhance wind resistance in hurricane-prone areas.

The advisory cites tile roofs' vulnerability to breakage from wind-borne debris and FEMA-observed performance problems with mortar-set, mechanically attached and foam-adhesive-set tile attachment methods. In many instances, FEMA attributes the damage to poor installation.

Because FEMA's investigations revealed mortar-set tile was much more susceptible to damage, FEMA only provides recommendations applicable to mechanically attached and foam-adhesive-set tile in its Hurricane Recovery Advisory No. 3. Therefore, one can conclude FEMA does not recommend the use of mortar-set tile in hurricane-prone regions.

The advisory provides additional recommendations applicable to uplift loads and resistance, hips and ridges, critical and essential buildings, and quality control.

The advisory recommends uplift loads and pressure on tiles be determined according to the current edition of the *Florida Building Code* or *International Building Code*, whichever applies to a specific building location. For mechanically attached tile, attachment should be determined according to the Florida Roofing, Sheet Metal and Air Conditioning Contractors Association (FRSA) Inc.'s *Concrete and Clay Roof Tile Installation Manual, Third Edition*, with the latest addendum. For foam-adhesive-set tile, foam-adhesive manufacturers should be consulted for uplift-resistance data.

For mechanically attached and foam-adhesive-set tile systems where the basic wind speed is 110 mph (49 m/sec) or greater, the advisory recommends a clip be installed at each tile in the first course of tiles along eaves.

At hips and ridges, the bulletin recommends the use of ridge boards and mechanical attachment of hip and ridge tile.

For critical and essential buildings defined as Category III or Category IV by ASCE 7, "Minimum Design Loads for Buildings and Other Structures," that are expected to remain operational during high-wind events, the advisory indicates roof tile is not recommended. However, if tile is used on these building types and is mechanically attached, the advisory recommends the use of tile clips at all tiles in corner, ridge, perimeter and hip zones as defined in ASCE 7.

Regarding quality control, the advisory recommends an applicator designate a knowledgeable quality-control person. For tile being installed on essential buildings, the advisory recommends a building owner retain a qualified architect, engineer or roof consultant to provide full-time field observation during application.

NRCA's comments

In some instances, the recommended enhancements contained in FEMA's guidelines are practical, effective means of improving the wind resistances of roof systems. For example, the underlayment enhancements described in Hurricane Recovery Advisory No. 1, Option 1 and Option 2, should effectively provide some degree of weather protection to a building and its contents in the event of asphalt shingle blow-off.

Perhaps in Option 1, applying a self-adhering modified bitumen membrane sheet directly to the roof sheathing would be more effective than applying it over an underlayment sheet that is nailed to the roof sheathing. Applying a self-adhering underlayment adhered directly to roof sheathing is a more standard industry practice and does not rely on the No. 30 underlayment lying flat and attachment of the underlayment to the roof sheathing for successful performance.

Regarding Option 2, NRCA considers the number of fasteners recommended to attach the two-layer underlayment to the roof sheathing to be excessive. The recommended number of fasteners in Option 2 is nearly twice the number of fasteners recommended in Option 1.

Nevertheless, NRCA agrees with FEMA in considering enhancing underlayment in asphalt shingle roof systems to be a practical, low-cost means to provide an additional degree of weather protection to a building and its contents in the event of asphalt shingle blow-off.

However, NRCA does not agree with many of FEMA's recommendations contained in Hurricane Recovery Advisory No. 2 and Hurricane Recovery Advisory No. 3. In NRCA's opinion, most of FEMA's recommendations for enhancing asphalt shingle roof systems and some recommendations for enhancing tile roof systems largely are unsubstantiated, misguided and contrary to industry best practices.

NRCA and others who have assessed the hurricanes' damage believe most roof systems that were designed and installed according to current applicable building codes performed adequately during the hurricanes. In most instances, the roof systems NRCA knows to have sustained considerable damage were those that did not comply with current buildings codes, which contain much more stringent high-wind provisions than the codes' previous editions. In many instances, the damaged buildings and roof systems of which NRCA is aware were constructed before the current codes were adopted. It is unreasonable to expect buildings and roof systems to perform to the level of current building codes if the buildings were designed and constructed based on previous, less stringent code editions.

In Hurricane Recovery Advisory No. 2, FEMA recommends using asphalt shingles with fastener pull-through resistance values in excess of what is provided in ASTM product standards. This recommendation is impractical, particularly when asphalt shingle manufacturers currently are not willing to represent physical property values in excess of those prescribed in ASTM standards. (For additional information, see "Asphalt shingle standards and compliances," page 72.)

Hurricane Recovery Advisory No. 2 also recommends using asphalt shingles complying with UL 2390 and ASTM D6381 and applying an additional factor of safety of 2.0 to the asphalt shingle's bond strength value. At the time this advisory was published in September 2004, no manufacturer had a listing for complying with these test methods. As of March, only one manufacturer has obtained an Underwriters Laboratories (UL) Inc. listing based on these tests. Also, when using the UL 2390/ASTM D6381 methodology, applying an additional safety factor to the asphalt shingle's bond strength is unnecessary and inappropriate because the necessary safety factors already are contained within the two test methods.

Also, this advisory recommends use of large amounts of asphalt cement at starter strips, rakes, and hips and ridges, which is contrary to industry standard practices and may prove counterproductive. The use of large amounts of field-applied asphalt cement as a shingle tab sealant contradicts the purpose of the advisory's prescribed bond strength values. Also of concern is the potential for the asphalt cement to cause blistering or other damage to the shingles and staining of the shingles and adjacent fascia.

In Advisory No. 3, FEMA indicates much of the damage to tile roof systems was a result of poor workmanship; however, FEMA has not substantiated this claim. FEMA appears to have implied a recommendation to not use mortar-set tile in hurricane-prone regions or any type of roof tile on critical or essential buildings. These are broad, far-reaching recommendations made with little or no substantiation.

Closing thoughts

If FEMA's true intent with the advisories is to assist the communities affected by the 2004 hurricanes, it has fallen short. These advisories would have been much more effective had they been written in a more basic, homeowner-friendly manner and

contained provisions that readily are achievable and supported by the roofing industry. Instead, the advisories are written at an advanced level geared toward design professionals or building code officials and contain provisions not readily achievable or supported by the roofing industry.

It appears FEMA's intent with these advisories is to motivate the roofing industry to improve the hurricane resistances of asphalt shingle and tile roof systems through local, community-level demand. If this is FEMA's intent, it is going about it the wrong way.

For example, FEMA's recovery advisories regarding underlayment and asphalt shingles were developed by FEMA with no known input or review by asphalt shingle manufacturers, the shingle manufacturers' trade association or NRCA. Similarly, the advisory addressing tile roof systems was developed allowing for only a limited review opportunity by NRCA, FRSA and the Tile Roofing Institute. FEMA accepted few of NRCA's review comments regarding this advisory.

Enhancing the wind resistance of roof systems in hurricane-prone regions is best achieved if all interested parties work cooperatively together in developing appropriate guidelines. As it has done in the past, NRCA remains available to work with FEMA in such an undertaking.

Mark S. Graham is NRCA's associate executive director of technical services.

Web-exclusive information — FEMA's three Hurricane Recovery Advisories